

SOME NOTES ON THE DETECTION OF NEUTRALS
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I have reviewed the previous studies¹ of this question and wish to record the following remarks.

Because of the small transverse momentum in strong interactions at high energies, we expect many of the secondaries to be concentrated in a very forward cone. If we assume an upper limit to transverse momentum of 600 MeV/c, we expect an opening half angle of 1.2 mrad for 50 GeV/c. It should be reasonably easy to detect the γ from π^0 going forward in the cone using either plates or Ne mixture.

In particular, one need not worry about the picture being cluttered by charged particles since a 40-kG field will displace the positive and negative forward cones each by about 30 cm at a distance of 5 m from the interaction. This, of course, is true only if one has a γ -detection region some distance behind the production with nothing more dense than the liquid H_2 in between.

If one detects both γ from a forward π^0 it is relatively easy to identify them as coming from a π^0 by computing the invariant mass of the pair. The formula is

$$M^2 = p_1 p_2 \theta^2.$$

where p_1 and p_2 are the measured γ momenta; θ is the opening angle between the γ rays.

On the other hand, it seems quite unreasonable to suppose that the pion momentum can be determined with sufficient accuracy to discover another pion that is missing.

The formula given above is also approximately true for the decay of K^0 and Λ^0 . We conclude that it should be possible to distinguish these decays from e^\pm pairs and from each other.

In addition to this forward cone of particles, we expect perhaps an equal number of particles which are produced at the target vertex and come off at large angles with low momenta in the lab. Neutral pions of this kind will have opening angles of 30° or more. Often one of the γ will have an energy less than 100 MeV. Gammas of this kind can be used to reject events but probably not for reconstruction. Neutrons at large angles can be detected through proton recoils. Unfortunately, these recoils are very short (~ 1 cm) and the hydrogen thickness for 50% chance of making a recoil is about 6 m. I believe the scanning efficiency for these recoils spread over so large a volume will be poor. It cannot be improved by guided scanning, in which one uses momentum balance to compute a direction for a detailed search. We would need momentum measurement accuracy of ± 30 MeV/c to get a reasonably accurate direction. This is a much tighter requirement than has yet been made in discussions of charged-particle detection.

REFERENCE

- ¹CERN/ECFA 67/16 Vol. 1; UCRL-16830; BNL-12400.